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13. ABSTRACT (Maximum 200 words) At the Research Institute, U.S. Army Topographic Engineering Center (TEC) we are developing empirical models to predict background surface temperatures and thermal contrasts, using continuous, long-term data collection in various climates. We are using a type-day concept to bound and group the values of radiation and other meteorological parameters into typical, somewhat unique weather conditions. Type-days are differentiated mainly by limits on integrated short and long wave incoming radiation, which portray sky cover and atmospheric conditions. The inputs to the models are climate, season, sky cover and whether the bare soil is "wet" or "dry". We believe that existing, energy budget, surface temperature models are too complex in input variables and in operation, and that they cannot be simplified for tactical use. We also think that there is insufficient joint meteorological, radiometric and surface temperature data available.			
14. SUBJECT TERMS Empirical models, Background Surface Temperatures, Thermal Contrasts, Long-term Data Collection, Type-day Concept		15. NUMBER OF PAGES 16	
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Abstract

Outline

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18. Handout: "Radiation Data Bases"; Unpublished Report, Feb 1991

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TEC. FORT BELVOIR, VIRGINIA SITE

77° 08' 46" W long., 38° 44' 35" N lat., Elev. 30m
Humid Subtropical Climate; Data 1983-Present
Warm Summer, Constantly Moist
Half Hourly Records

No. of Inputs

Measurement

At Each Half Hour, Averaged, with 21 Samples in 2 min :

- ```

1 Global Short Wave Incoming Radiation (W/m2) in .2-2.8μm band
1 Global Long Wave Incoming Radiation (W/m2) in 3-50μm band
1 Global All Wave Incoming Radiation (W/m2) in .2-50μm band
3 Global Short Wave Net Radiation (W/m2) in .2-2.8μm band:
 Over Bare Soil, Cut Grass, and Uncut Grass & Weeds
3 Wind Speed Profile (m/s) @ 10cm, 1.2m, 15m
1 Wind Direction (Azimuth) @ 15m
2 Surface Radiometric Temperature (°C) in 8-14μm band, over:
 Cut Grass
 Uncut Grass and Weeds
 Bare Soil
 Gravel
 Shrubs
 Fir Tree
 Deciduous Forest
 Buried Rock
 Camouflage Net
 M114 Armored Reconnaissance Vehicle

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**Measured Every 30 min :**

- ```

1      Cumulative Precipitation (mm)
1      Barometric Pressure (mb)
10     Air Temperature Profile (°C) @ 10,50cm, 1.2,2,3,4,6,8,10,12m
1      Dew Point Temperature (°C) @ 1.2m
56     Soil Temperature (°C) in 8 Profiles @ 1,2,6,10,20,40,80cm
8      Soil Heat Flux (W/m²) in 2 Profiles @ 2,6,10,20cm depths
72     Soil Moisture Resistance (Ohms) in 6 Profiles @ 2,6,10,20cm
3      Buried Rock Temperature; (°C) @ Top, Center, Bottom
2      Armored Recon Vehicle Temperature (°C), Skin and Internal Air
6      Housekeeping and Self Calibration

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TOTAL

JORNADA EXPERIMENTAL RANGE (USDA), LAS CRUCES, NEW MEXICO SITE

107° 45' 00" W long., 32° 38' 00" N lat., Elev. 1323m
 Chihuahuan Desert: ISLSCP/ NASA International Site for Study of Arid Lands
 Semiarid to Arid Climate : Data 1986-Present
 Cool Winter (Dry), Warm Summer (with Precipitation)
 50 yr Record of Vegetation and Soil Changes (Erosion)
 Soil and Vegetation Maps
 Cooperative Site with USAETL, USGS, USDA, UNM

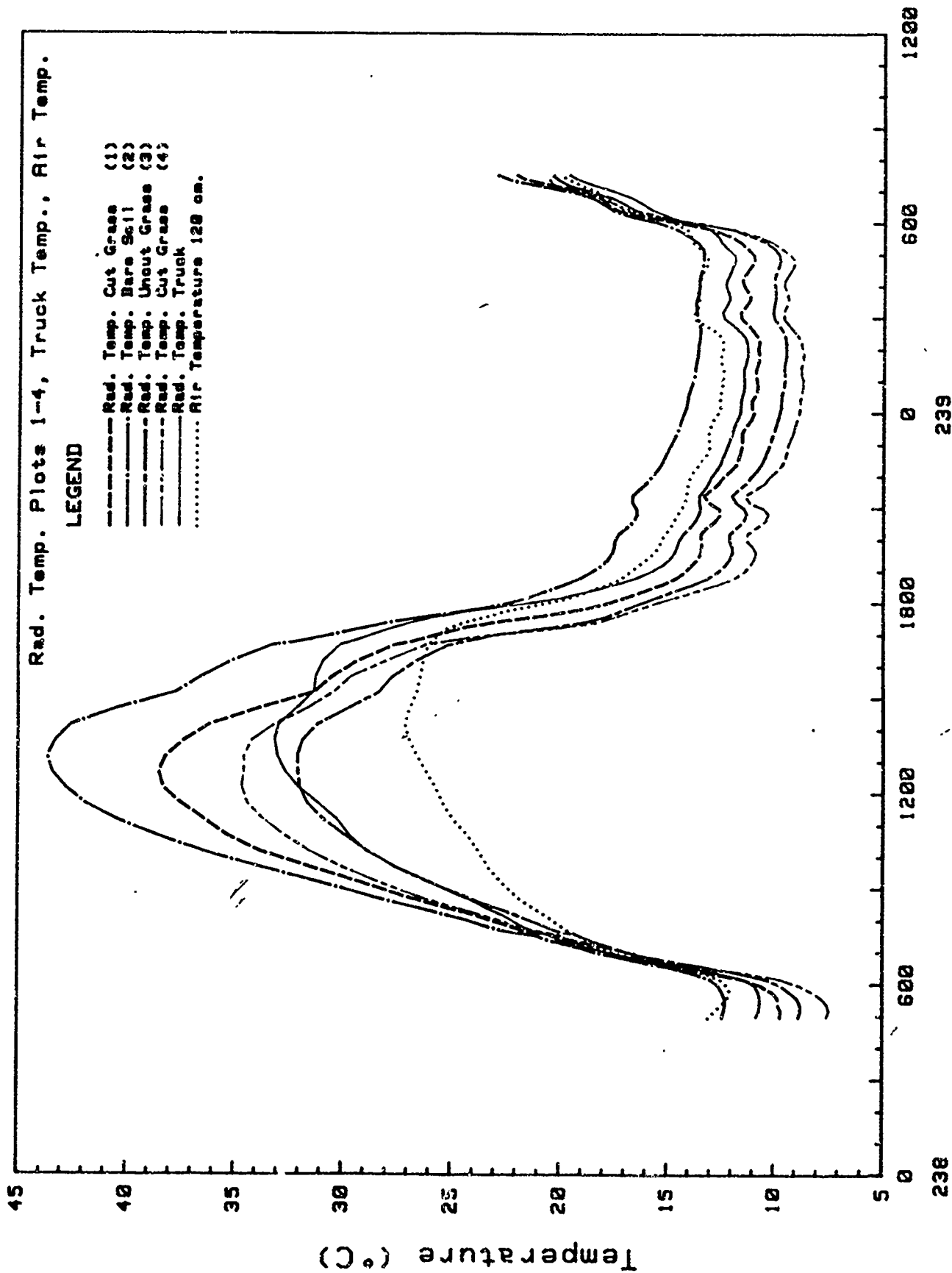
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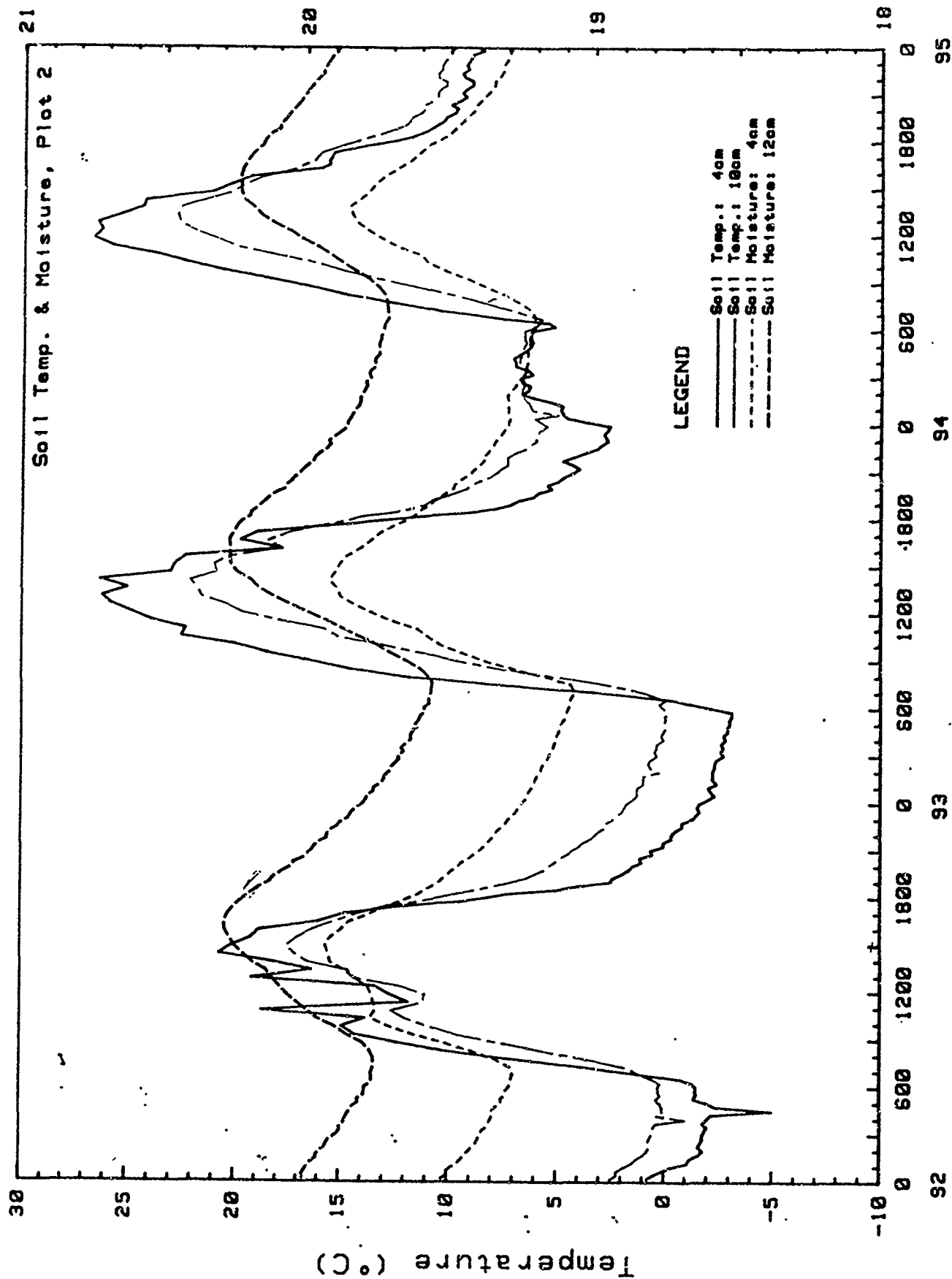
YUMA MARINE CORPS AIR STATION, GOLDWATER RANGE, ARIZONA SITE

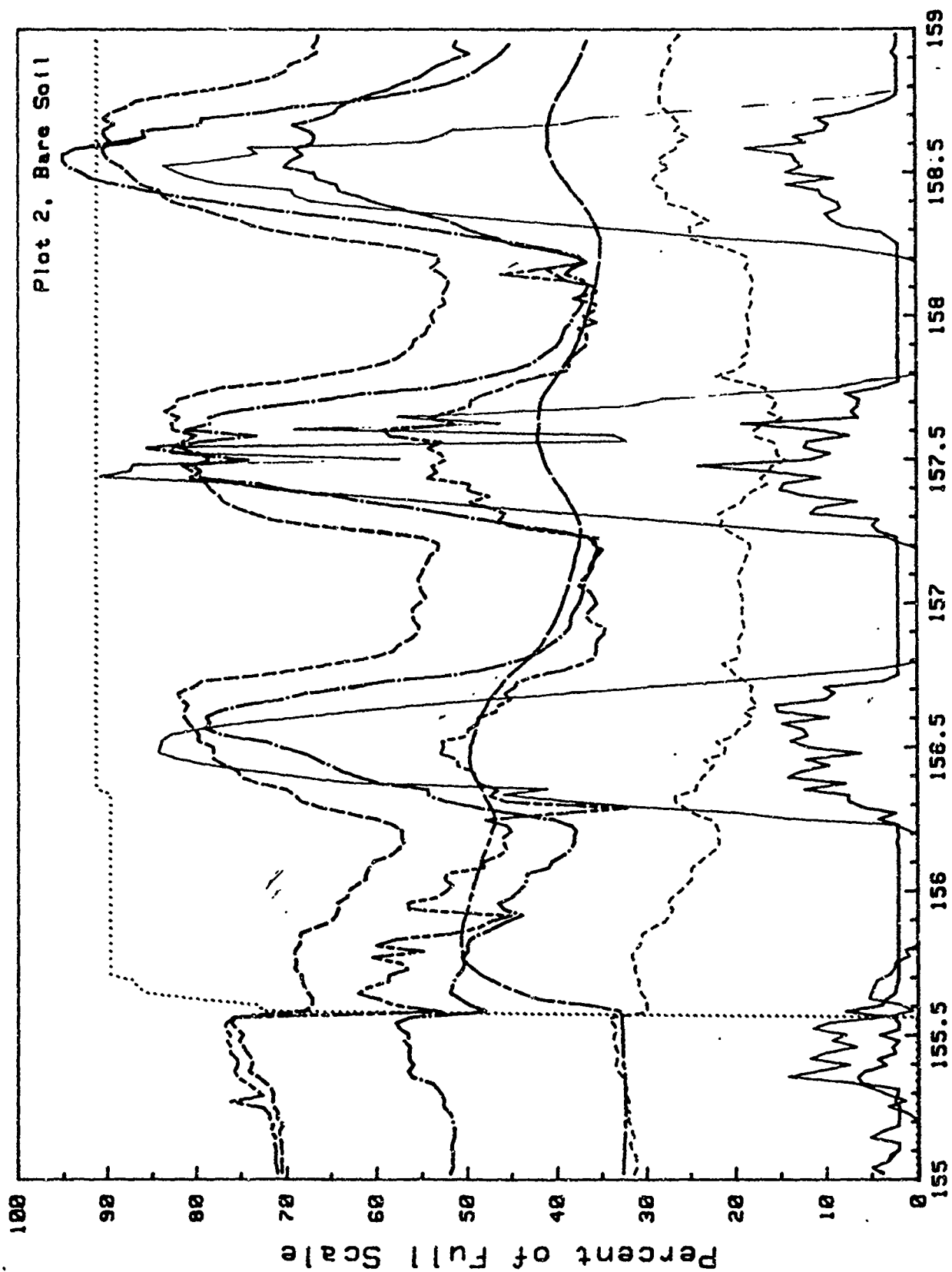
114° 31' 27" W long., 32° 32' 06" N lat., Elev. 75m
 Lower Sonoran Desert
 Arid Climate : Data 1988- Present
 Mild Winter (with Precipitation), Spring (Dry)
 Hot Summer (with Precipitation), Autumn (Dry)
 7 years previous Met Data, USGS Desert Winds Site
 Cooperative Site with USGS, Flagstaff, AZ

Both, Solar/Battery Powered Remote Sites, using GOES Telemetry
 [Periodic, Field Spectral Reflectance Measurements]
 6min, 12min, and 60min Data Averaging

No. of Inputs	Measurement	Sampling Interval
Averaged Every 6 min :		
3	Wind Speed Profile (m/s) @ 1.3m, 2.4m, 6m	1sec
	Wind Speed Peak Gust (m/s) @ 1.3m, 6m	1sec
1	Wind Direction (Azimuth) @ 6m	10sec
1	Sand Flux Momentum Average @ 10cm	1sec
	Sand Flux Momentum Peak	1sec
Measured / Averaged Every 12 min :		
1	Global Short Wave Incoming Radiation (W/m ²) [.2-2.8μm]	10sec
1	Global Short Wave Outgoing Radiation (W/m ²) [.2-2.8μm]	10sec
1	Global Long Wave Incoming Radiation (W/m ²) [3-50μm]	10sec
1	Global Long Wave Outgoing Radiation (W/m ²) [3-50μm]	10sec
1	Cumulative Precipitation (mm)	12min
2	Air Temperature Profile (°C) @ 1.3m, 6m	12min
4	Surface Radiometric Temperature (°C) Shrubs and Soil	10sec
2	Soil Heat Flux (W/m ²) @ 2cm depth	10sec
Measured / Averaged Every 1 hr :		
1	Barometric Pressure (mb)	1hr
1	Humidity (%) @ 1.3m	1hr
3	Soil Temperature Profile (°C) @ 4cm, 10cm, 20cm depths	1hr
1	Soil Moisture (%) @ 4cm depth	10sec
1	Battery Voltage (V)	1hr







Meteorological Site Classification

TEC Site Ft Belvoir, VA

Site Data, 1986-1988

SEPTEMBER SEASON

Mean Air Temp (C)	Max Air Temp (C)	Min Air Temp (C)	Mean Dew Pt. (C)	Mean Baro. Press. (mb)	Mean Lwi	Max Lwi (W/m^2)	Min Lwi	Area Swi Curve (W/m^2 *hr)	Area Wind Curve (m/s *hr)	Max Soil Moist (%/wt)
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Type Days:

Clear-Dry

16.2	31.5	4.2	9.4	1026	333	466	216	5760	12.2	10.2
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Partly Cloudy-Dry

20.8	32.7	9.0	15.3	1020	387	474	256	4402	11.1	10.2
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Partly Cloudy-Wet

22.2	29.5	13.7	17.9	1013	383	480	253	4160	8.2	11.0
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Overcast-Dry

20.3	26.3	13.9	16.4	1018	412	566	340	1362	10.0	10.1
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Overcast-Wet

20.2	23.5	15.9	18.0	1014	413	436	361	1738	6.7	11.0
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Overcast-Rain

20.9	25.6	17.7	19.1	1016	416	468	363	712	7.6	11.0
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INPUTS
to
USA WES Terrain Surface Temperature Model with
'VEGIE' Vegetation Temperature Model

1. Time Step Interval Between Inputs
2. Shelter Height at which Weather Data is Measured (cm)
3. Number of Systems ,or Different Backgrounds
4. System Index, or Interval Between Measurements
5. Number of Measurements in Soil Temperature Profile
6. Number of Layers in the System
7. Layer Thickness (cm)
8. Grid Spacing of each layer (arbitrary) (cm)
9. Thermal Diffusivity for each layer (cm^2/min)
10. Thermal Conductivity for each layer ($\text{cal}/\text{min cm K}$)
11. Long Wave Emissivity of the Surface (0-1)
12. Short Wave Adsorbtivity of the Surface (0-1)
13. Wetness of the Surface (0-1)
14. Bottem Boundary Condition Indicator (-1,0,1)
15. Bottem Boundary Temperature or Flux ($^{\circ}\text{C}$ or $\text{cal}/\text{cm}^2 \text{ min}$)
16. Vegetation Presence Indicator (Yes/ No) (0,1)
17. Vegetation Coverage Factor (0-1)
18. Vegetation Stress Factor (0-1)
19. Vegetation Long Wave Emissivity (0-1)
20. Vegetation Short Wave Adsorbtivity (0-1)
20. Vegetation Height (cm)
21. Barometric Pressure (mb)
22. Soil Temperature Profile ($^{\circ}\text{C}$)
23. Air Temperature at Shelter ($^{\circ}\text{C}$)
24. Relative Humidity or Dew Point Temperature at Shelter (% or $^{\circ}\text{C}$)
25. Long Wave Incoming Irradiation (W/m^2) or Cloud Cover (%)
26. Short Wave Incoming Irradiation (Insolation) (W/m^2)
27. Average Wind Speed (m/s)
28. Time
29. Latitude ($^{\circ}$)
30. Surface Azimuth ($^{\circ}$)
31. Surface Slope ($^{\circ}$)

INPUTS TO TEC SURFACE TEMPERATURE MODEL

1. CLIMATE

Humid Subtropical
Semiarid
Arid

2. SEASON

Summer (Jun, Jul, Aug)
September
October
November
Winter (Dec, Jan, Feb)
March
April
May

3. SKY CONDITIONS AND SURFACE SOIL MOISTURE

Clear, Dry
Clear, Wet
Clear, Snow
Partly Cloudy, Dry
Partly Cloudy, Wet
Partly Cloudy, Snow
Overcast, Dry
Overcast, Wet
Overcast, Rain, Wet
Overcast, Snow

4. BACKGROUND OR THERMAL CONTRAST

Camouflage Net
Bare Soil
Cut Grass
Uncut Grass
Gravel
Fir Tree
Rock
M114 Armored Reconnaissance Vehicle
M114- Cut Grass
M114- Bare Soil
M114- Uncut Grass
M114- Gravel
M114- Fir Tree
M114- Rock

